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Two new *Puccinia* species on *Melica* (*Poaceae*) from USA

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Abstract—During a study of herbarium specimens of graminicolous rust fungi from the USA deposited in the Arthur Fungarium (PUR), two previously undescribed species infecting *Melica* spp. were encountered. Described as *Puccinia melicae-porteri* sp. nov. and *P. goldsbroughii* sp. nov., they are compared to similar rust fungi on *Melica* spp. from around the world. A key to the fourteen *Puccinia* species on *Melica* spp. is provided.

Key words—mycobiota, *Pucciniales*, North America

Introduction

The genus *Melica* (*Poaceae* trib. *Meliceae*) comprises about 80 species worldwide (Clayton & Renvoize 1986). Members of this genus are host to 12 *Puccinia* species. Cummins (1971) reported eight *Puccinia* species on *Melica*: *P. trebouxii* Syd. & P. Syd., *P. graminis* Pers., *P. coronata* Corda s. lat., *P. paradoxica* Ricker, *P. brachypodii* G.H. Otth s. lat., *P. schedonnardi* Kellerm. & Swingle, *P. poarum* Nielsen, and *P. abramoviana* Lavrov. Four additional species have subsequently been reported on *Melica*: *Puccinia pygmaea* Erikss., *P. montanensis* Ellis, *P. persistens* Plowr., and *P. recondita* Dietel & Holw. (Arthur 1934, Tranzschel 1939, Lindquist 1982, Azbukina 1984, French 1989). Index of Fungi (1970–2011) and Farr & Rossman (2015) cite no reports of other *Puccinia* species on *Melica*. As part of a planned study of graminicolous rust fungi in the USA, specimens of *P. schedonnardi* sensu Cummins (1971) on *Melica* spp. deposited in the Arthur Fungarium (PUR) were revised. Our research revealed two species that are morphologically distinct from all previously reported *Puccinia* species on *Melica* and which we describe here.

Materials & methods

Herbarium specimens from PUR were used for this study. Microscopic measurements and photomicrographs were made from material mounted in lactic acid in glycerol (Kirk et al. 2008). At least 30 spores were measured from each specimen. Photomicrographs were taken with a Nikon Digital camera mounted on a Nikon Eclipse 80i microscope. Terminology follows Cummins & Hiratsuka (2003). Spore stages are indicated by conventional symbols: II = uredinia; III = telia.

Taxonomy

Puccinia melicae-porteri M. Abbasi & Aime, **sp. nov.** Pl. 1

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Differs from other *Puccinia* spp. on *Melica* by frequent teliospores with a conical apex or a beak-like projection (tapering rostrum).

Type: USA, Colorado, Manitou, Garden of the Gods, on *Melica porteri* Scribn., 18 Oct. 1919, leg. Bethel, II+III (**Holotype**, PUR 21317, as *Puccinia schedonnardi*).

Etymology: Named after its host species, *Melica porteri*.

Uredinia on stem and on adaxial leaf surface, elliptic or oblong, golden brown; urediniospores ellipsoid or more or less globoid, 25.6–31.2 × 22.4–25.6 µm, wall pale brown, 1.6–2 µm thick, echinulate, with 7–8 scattered germ pores with slight to moderate internal ring and small pore cap. Telia mostly on the stem (occasionally on adaxial leaf surface), narrowly oblong or linear ≤2 cm long, exposed, semi-compact, and blackish, mostly surrounded by ruptured epidermis; teliospores variable in shape, clavoid, oblong-clavoid or fusiform, slightly constricted at septum, rounded, truncate, narrowly conical or with one or (rarely) two beak-like projections (tapering rostrum) at apex, 35.2–61 × 15.2–27.2 µm, walls smooth, chestnut brown at apex, lighter below, 1.5–2.5 µm thick at sides, ≤10.5 µm thick at apex (≤20 µm in spores with conical apex), pedicels thick-walled, ≤49.5 µm long. Mesospores present.

Additional specimens examined [all labelled as *Puccinia schedonnardi*]:

On *Melica porteri*: USA, Colorado, Manitou, Oct. 1919, E. Bethel, III (PUR 21319); Manitou, Garden of the Gods, Glen Eyrie, 27 Sept. 1919, Bethel, II+III (PUR 21318).

The above combination of morphological features distinguishes *P. melicae-porteri* from all previously described *Puccinia* species on *Melica* spp. (Cummins 1971, Farr & Rossman 2015). The closest species to *P. melicae-porteri* is *P. neocoronata*, a rust originally described on *Piptochaetium* and *Stipa* (both from *Poaceae* trib. *Stipeae*). In addition to the host, *Puccinia melicae-porteri* differs from *P. neocoronata* in having mostly caulicolous telia, more morphologically diverse teliospores, and smaller urediniospores with paler walls.

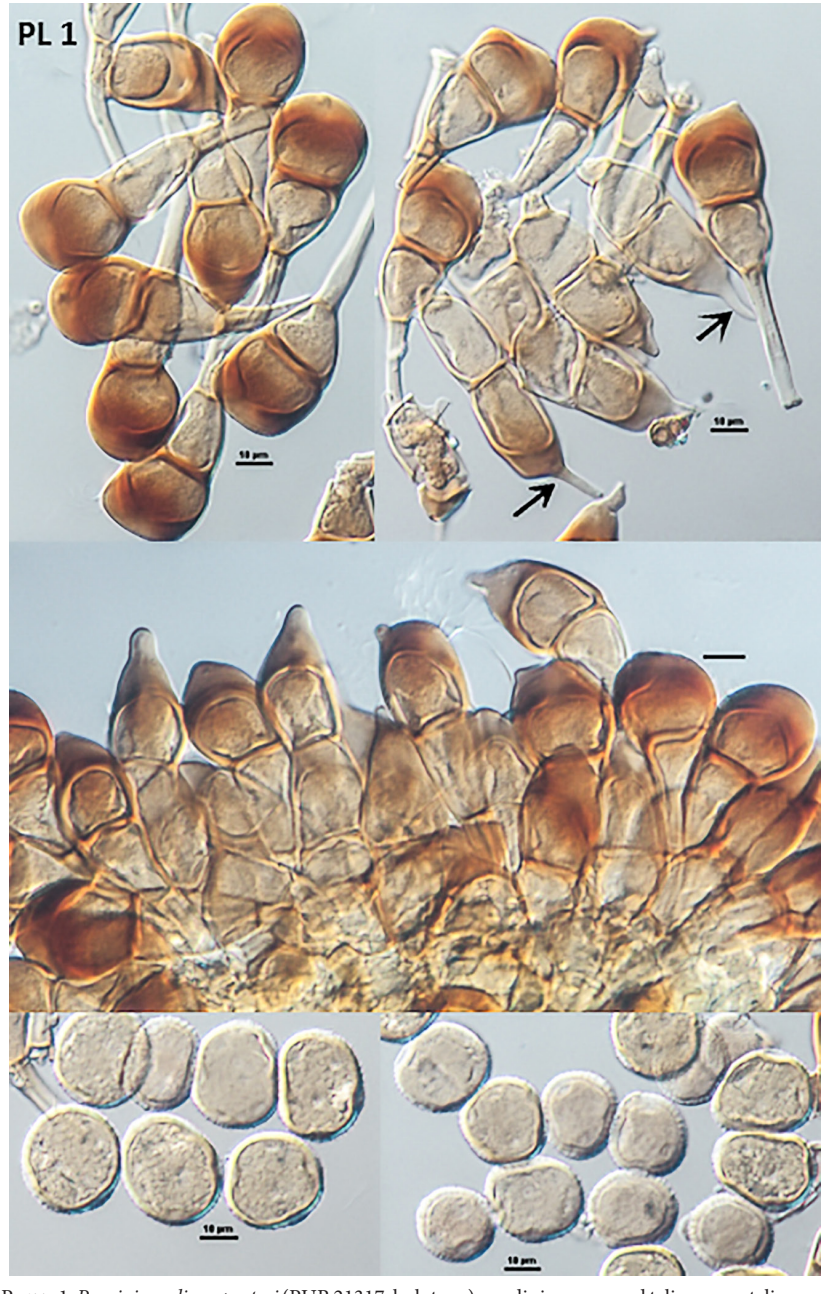

Plate 1. *Puccinia melicae-porteri* (PUR 21317, holotype): urediniospores and teliospores; teliospore apex truncate, rounded, conical or with beak-like projection (arrows). Scale bars = 10 µm.

Puccinia goldsbroughii M. Abbasi & Aime, **sp. nov.** Pl. 2

MycoBank MB 814389

Differs from *Puccinia trebouxii* in its smaller teliospores and thin-walled urediniospores with scattered or bizonate germ pores.

Type: USA, Missouri, south of Pierpont, Missouri, on *Melica nitens* (Scribn.) Nutt. ex Piper, 24 Jun. 1933, leg. W.E. Maneval, II+III (**Holotype**, PUR 47968, as *Puccinia schedonnardi*).

Etymology: After Prof. Peter Goldsbrough, Department Head of Botany and Plant Pathology, in recognition for his support of the Arthur Fungarium.

Uredinia cinnamon-brown, oblong, amphigenous, mostly on the adaxial leaf surface and stems, sometimes arranged in short rows, first covered by epidermis and later pulverulent, ruptured epidermis around sori is conspicuous; urediniospores more or less globoid, ellipsoid or obovoid, 25.6–32 × 23.2–28 µm, wall 1.6–2 µm thick, densely echinulate, pale-brown, germ pores 6–8, scattered or bizonate with small pore cap. Telia oblong or linear, mostly on adaxial leaf surface and also on the stem, first covered by epidermis, later exposed, semi-compact, blackish brown with a shining appearance, teliospores mostly obovoid-clavoid or oblong, (28–)32–44(–49.6) × 17.6–26.4 µm, rounded, truncate, acuminate or obliquely acuminate at apex and generally tapering downwards, wall smooth, 2–3.5 µm at sides, and ≤12 µm at apex, clear chestnut brown, lighter towards the base and at apex especially in acuminate spores, pedicels short (≤35 µm), mostly shorter than spore length, dark brown below the attachment point to the spore, pale or yellowish brown downward. Mesospores present, common in some telia.

Additional specimens examined [all labelled as *Puccinia schedonnardi*]:

On *Melica* sp.: USA, **Indiana**, Lafayette, 29 July 1899, Wm. Stuart, II+III (PUR 21315); 18 July 1906, J.C. Arthur, II+III (PUR 21347); Lafayette, Elston, 31 Dec. 1896, Wm. Stuart, III (PUR 21348); 22 Oct. 1899, Stuart, II+III (PUR 21314); Lafayette, near Elston, 14 Oct. 1912, J.C. Arthur, II+III (PUR 21372); Lafayette, Bayles Mills, 3 Sept. 1915, J.C. Arthur & H.S. Jackson, II+III (PUR 21360).

On *Melica nitens*: USA, **Indiana**, Lafayette, Bayles Mills, 13 May 1903, J.C. Arthur, II+III [III spores mostly germinated] (PUR 21313); 29 May 1903, J.C. Arthur, II (PUR 21312); **Mississippi**, Lumberton, 12 Aug. 1921, L.E. Miles, II+III (PUR 45590).

The above combination of morphological features distinguishes *P. goldsbroughii* from all previously reported *Puccinia* species on *Melica* (Cummins 1971, Farr & Rossman 2015). *Puccinia trebouxii*, which was originally described from Samarkand (Uzbekistan), is the morphologically closest species to *P. goldsbroughii*, but differs from *P. goldsbroughii* in its wider teliospores (24–36 µm) and thick-walled (≤ 4 µm thick) urediniospores with occasionally equatorial germ pores. On one of the *P. goldsbroughii* paratypes (PUR 21313) teliospores had mostly germinated in telia, but this phenomenon was not observed on other examined material, including the holotype.

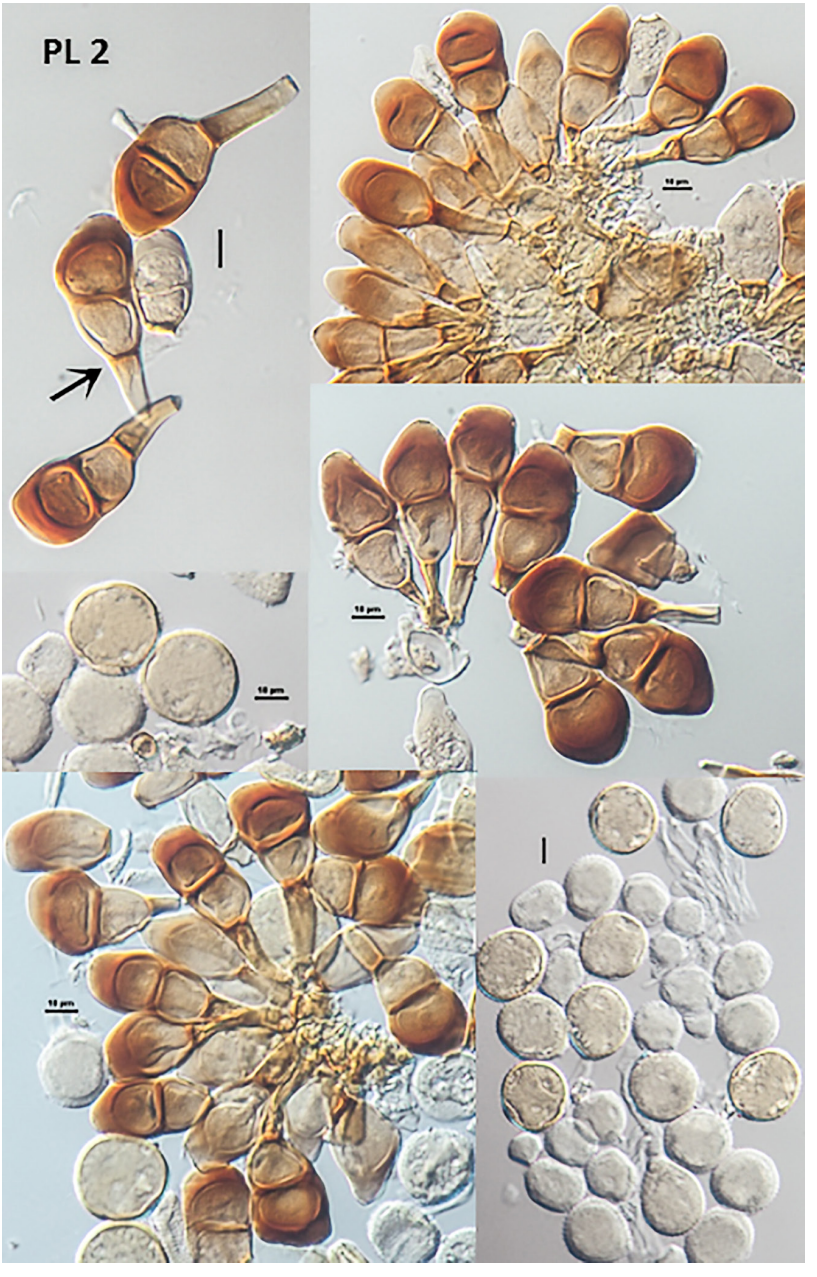

Plate 2. *Puccinia goldsbroughii* (PUR 47968, holotype): urediniospores, teliospores, and mesospores; arrow shows dark-brown part of pedicel below attachment point. Scale bars = 10 μm.

Key to the 14 *Puccinia* species on *Melica*

1. Teliospores verrucose ..... *P. paradoxica*
1. Teliospores smooth 2
2. Telia exposed 3
2. Telia covered 7
3. Teliospores with apical beak-like projection ..... *P. melicae-porteri*
3. Teliospores without projection 4
4. Urediniospore pores exclusively equatorial ..... *P. graminis*
4. Urediniospore pores scattered, occasionally equatorial 5
5. Teliospores mostly broadly ellipsoid, broadly obovoid or more or less globoid ..... *P. schedonnardi* s. str.
5. Teliospores mostly obovoid-clavoid or oblong 6
6. Teliospores 24–36 µm wide ..... *P. trebouxii*
6. Teliospores 17.6–26.4 µm wide ..... *P. goldsbroughii*
7. Teliospores with apical digitations ..... *P. coronata* s. lat.
7. Teliospores without apical digitations 8
8. Uredinia paraphysate 9
8. Uredinia aparaphysate 11
9. Paraphyses thick-walled ..... *P. brachypodii* s. lat.
9. Paraphyses uniformly thin walled 10
10. Teliospores mostly 22–32 µm wide ..... *P. montanensis*
10. Teliospores mostly 17–22 µm wide ..... *P. pygmaea*
11. Urediniospores verrucose ..... *P. abramoviana*
11. Urediniospores echinulate 12
12. Urediniospore wall colorless or pale yellowish ..... *P. poarum*
12. Urediniospore wall brownish 13
13. Teliospores mostly 35–70 µm long ..... *P. recondita* s. str.
13. Teliospores mostly 34-46 µm long ..... *P. persistens*

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